SHIP PRODUCTION COMMITTEE
FACILITIES AND ENVIRONMENTAL EFFECTS
SURFACE PREPARATION AND COATINGS
DESIGN/PRODUCTION INTEGRATION
HUMAN RESOURCE INNOVATION
MARINE INDUSTRY STANDARDS
WELDING
INDUSTRIAL ENGINEERING
EDUCATION AND TRAINING

June 1978
NSRP 0005

THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

REAPS 5th Annual Technical Symposium Proceedings

Paper No. 2: An Approach For the Use of Interactive Graphics In Part Definition and Nesting

U.S. DEPARTMENT OF THE NAVY
CARDEROCK DIVISION,
NAVAL SURFACE WARFARE CENTER

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
JUN 1978	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
The National Shipbuilding Research Program REAPS 5th Annual Technical Symposium Proceedings Paper No. 2: An Approach for the Use of Interactive Graphics in Part Definition and Nesting	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Naval Surface Warfare Center CD Code 2230 - Design Integration Tools Building 192 Room 128 9500 MacArthur Blvd Bethesda, MD 20817-5700**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

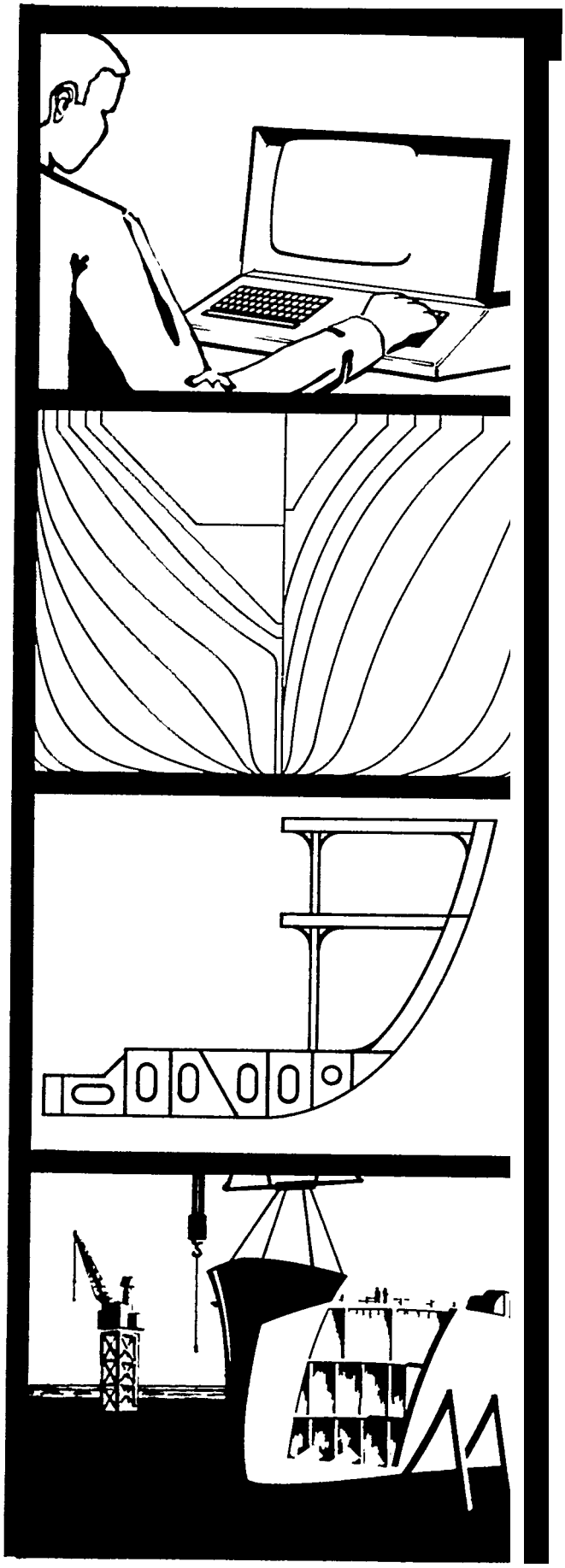
13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**SAR**	**12**	

NSRP-0005



R ESEARCH
AND
E NGINEERING
FOR
A UTOMATION
AND
P RODUCTIVITY
IN
S HIPBUILDING

Proceedings of the REAPS Technical Symposium

June 27-28,1978

St. Louis, Missouri

DISCLAIMER

These reports were prepared as an account of government-sponsored work. Neither the United States, nor the United States Navy, nor any person acting on behalf of the United States Navy (A) makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness or usefulness of the information contained in this report/ manual, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or (B) assumes any liabilities with respect to the use of or for damages resulting from the use of any information, apparatus, method, or process disclosed in the report. As used in the above, “Persons acting on behalf of the United States Navy” includes any employee, contractor, or subcontractor to the contractor of the United States Navy to the extent that such employee, contractor, or subcontractor to the contractor prepares, handles, or distributes, or provides access to any information pursuant to his employment or contract or subcontract to the contractor with the United States Navy. ANY POSSIBLE IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR PURPOSE ARE SPECIFICALLY DISCLAIMED.

AN APPROACH FOR THE USE OF INTERACTIVE GRAPHICS IN PART DEFINITION AND NESTING

Arthur F. Kaun
Newport News Shipbuilding and Dry Dock Company
Newport News, Virginia

Mr. Kaun is the production computer systems supervisor at NNSDD where he is currently responsible for the support of steel fabrication computer systems. This includes developing an interactive graphics approch to parts definition for Newport News in accordance with the MarAd funded project and the general support of AUTOKON and related computer systems.

Mr. Kaun has a degree in mathematics from the University of Michigan.

An Approach for Use of Interactive Graphics in Part Definition and Nesting

A year ago I spoke about the feasibility study we at Newport News were going to do-toward a mini based interactive graphics sysyem for parts definition. Here I am again, and anyone could justifiably ask - what have you done in a year? In fact we've been asked that question along with being complemented on inventing the best boondoggle at Newport News in recent memory. But it hasn't been that much fun - in fact it has been more like frustration trying to reach a bottom line. Today, I'd like to tell you some of the complexities connected with this project to show you why it-has been difficult to reach a final conclusion.

There are two major areas of complexity:

1. Project Constraints
2. Market place constraints

PROJECT CONSTRAINTS

1. Parts Definition Philosophy - There are numerious ways to define steel parts and each yard favors some subset of these. Interactive graphics is just one of these and not necessarily the obvious best choice right now. Those I know of are:
   - Optical negatives
   - Digitizing
   - Part Coding
   - Part Splitting
   - Direct ESSI
   - APT
   - Interactive Graphics

1. (Continued)

The philosophy differences come in on whether interactive coding should be the best approach toward speeding the process, or perhaps using AUTOKON NORMS in a digitizing system or even letting the Design office put the parts in numerical form rather than the Mold Loft. We've also heard philosophy differenceson whether the source code or the part geometry itself should be kept as the true record of the part. In other words, Parts Definition is different things to different people.

2. MARAD Involvement - The details of the U.S. Government being involved in the procurement of hardware and software had to be explained to each vendor contacted. These details revolved around software improvements entering into the public domain, distribution rights of MARAD within REAPS and distribution of hardware and software within each shipyard for multiple systems. It would have been easy if only Newport News were buying the system, but it's a different story when you're talking about a system for possible use by multiple companies under the distributorship of the MARAD branch of the Federal Government.

3. Shipyard Size - When dealing with a number of shipyards, the question naturally arises - what can each justify in the area of interactive graphics? While some can justify a large mini computer configuration with numerous work stations, others will only be able to justify one work station and may want to connect it to an already existent mini or host comppter system. Some yards may not have enough volume of work to even considers new method of defining NC parts, and some will find that parts definition ranks low on a list of projects for which better returns on investment are available.

4. Autokon-Spades-Steerbear - These three shipbuilding systems are all similar in what they do, yet different in technique and data structure. A graphics part definition system would conceivably' have to interface to each. What is this interface, is it feasible and who will do it are all questions that will eventually have to be answered. Also, are the system philosophies of each so different that a graphics parts definition system couldn't serve as an exteniion of all three?

5. Portability - This has been one of the biggest constraints. With varying needs across yards, how do you satisfy all? If the final result is a system that ties hardware and software to gether, each yard desiring the system would have to procure the whole -thing - hardware and software; Or if a system is designed that results in general software, not tied tightly to minis or scopes, each yard' can mix and match it's own configuration and obtain the capabilities each 'wants for the desired investment. While this approach sounds good, it has some drawbacks. Due to its generality, it would have to become more of a general tool and less of a tailored shipbuilding package. Furthermore, there would be no common package within REAPS and thus no opportunity to share improvements and jointly develop new features for everyone's benefit. To provide this general, portable system might well require more work by REAPS to establish interfaces to varying options. And finally, portability can lead to inefficiency by not allowing the software to take full advantage of any specific hardware features.

6. Sophistication - Each yard varies in its level and need for sophistication. Computer analyst staffs to support such a system way vary from 2-150 people. While some yards have been involved in NC systems for many years and have evolved expertise, others are just starting out and couldn't support anything very sophisticated as yet.

7. Short vs. Long Term Considerations - Each yard must look at its immediate and long term needs in this area, of parts definition. Some need aids now, while others don't see a need for some time to come. These needs are heavily influenced by production cycles which create volume and deadlines. Other yards might be considering changes in their product lines.

8. Yard Policy/Direction - Who is the user of such a system - Mold Loft, Design, Engineering? Should the Lofts job of parts definition be merged into design or should it remain part of the production environment? Furthermore, will each yard make available to such a system the lines and surfaces of a ship as a reference in defining parts? If so, this calls for more 'interfaces and new techniques. Each yard should further be looking at other applications that a graphics system might satisfy - such as drafting hull design, piping, electrical, machining, etc. A graphics system can also aid in producing documentation such as detail, shop and assembly drawings. This documentation will vary from yard-to yard.

9. Accuracy - What is needed by the shipbuilding industry? We keep hearing horror stories about ships being built too long or too short due to computer roundoff errors. Accuracy ranges from 1,600 feet lengths accurate to .01 mm; to 100 feet coordinate systems accurate to 1 mm.

MARKET PLACE CONSTRAINS

1. Technology The interactive graphics industry is a relatively young industry with new companies continuously entering into it. Software is constantly being improved as more systems are installed and used in industry. The micro-processor and inexpensive memories have brought rapid changes in the mini-computer, scopes and controller areas, at the same time challenging the software to take advantage of these improvements.

1. (Continued)

In essence, one could conduct's never ending feasibility study, because as soon as one is ready to decide, something new and better will pop up to be investigated further.

2. Refresh vs. Storage Tube - These are two separate technologies within computer graphics, each having-their own advantages and disadvantages. One difference is the cost difference, however the cost of refresh is rapidly decreasing. Is refresh really needed in shipbuilding? For parts definition it appears helpful although not essential, however interactive nesting appears to be an application well suited for real time movement on the screen. Further more, from those we've talked to refresh appears to be the techrtology of the future and thus more desirable, if the price can be paid now.

3. General vs. Specific Software - One will find two types of software on the market. One type features the basic building blocks of descriptive geometry, leaving it to the user to build any application packages he desires. Another type is the final application software, the disadvantage of which is that the building blocks aren't necessarily obvious for the user to take and build yet other application software. It appears that one can't have both types, although such a combination would be ideal.

4. Components vs. Total - The easy approach is to buy a completely integrated system from one vendor, but this will cause portability problems for some of the REAPS yards. On the other hand if it is more desirable to buy the components separately (mini, scopes, software, etc.), then one has to become an expert in each of these areas in order to choose the best components for the final system. This may become more time consuming than desired at each yard. Furthermore, solving the interface problems between the components may be more complex then they first appear.

Mainframe vs. Stand Alone Minis - Some yards might have the desire to run graphics software on a mainframe computer instead of a mini. Is this possible? There are some doubts, due to the need of graphics to execute in real time and the mainframe's ability to provide such service. Other considerations are the priority given to graphics as compared to other shipyard applications and the CPU demand made by the graphics software itself. A shipyard that desires to have work stations located remotely from the mini or mainframe computers, may find it difficult to accomplish due to response requirements over communication lines. A user should also consider the costs of providing operators and hardware maintenance should they choose to go with a mini computer. Finally, when a yard asks how many work stations will a graphics system support, it will receive various and all too often vague answers, due mainly to the unknown impact that any given work station would generate at any time.

Benchmarks - Benchmarks are necessary to evalute qraphics systems, however they don't yield as quantitative a result as one may desire. Because each benchmark is run on different hardware/software combination, the results are different. Because vendors are asked to do things instead of run programs, they often vary in how completely they satisfy a benchmark. Some are very thorough, while others only take time to run through a canned demonstration. Slightly different results are also obtained when a refresh system is being compared to a storage tube system. Some vendors offer geometric building blocks and use them to perform the benchmark, while other vendors write specialized programs to satisfy the benchmark. So even through it is difficult to line up interactive graphics system for comparison, by running a comprehensive benchmark, the vendor does demonstrate most of the strengths and weaknesses of his system. The buyer must then evaluate which areas are of most importance in choosing a system.

Accuracy - As mentioned previously, accuracy is a requirement for a shipbuilding system. Many of the vendors visited were surprised to hear this, especially since they have not been required to provide more than 5-6 place accuracy before now. To obtain the 8 place accuracy we felt necessary, a 16 bit mini computer would have to store coordinates in double precision integer, which exists on few if any 16 bit minis, and perform calculations in double precision floating point which is often slow on such, a small computer. The additional core and disk storage requirements for double precision would also be a drawback. Some vendors were surprised to find out that the accuracy they claimed to have didn't really exist when benchmarks were run to tesrt it.

CONCLUSION

With all of the above constraints one could ask - "Is it an impossible task?" We don't think so. It is our desire to obtain a flexible tool that can then be developed into an effective shipbuilding system for use in this industry as a whole.